PAWAN KUMAR

# Integrated Soil Fertility Management: Converting Subsistence Farming to Productive Farming

Maintaining or improving soil health is essential for sustainable and productive agriculture. ISFM strategies assist farmers in following a scientific process for cultivation without eroding the soil's inherent capacity to produce more by maintaining its fertility level.

DETERIORATION IN THE FERTILITY OF THE SOIL is a major concern for the sustainability of Indian agriculture. For centuries, the farmers of India have practised an agricultural system that ensures modest but stable yields and, yet, have maintained optimum soil fertility. This balance was interrupted by the widespread push for increased production with the introduction of high-yielding varieties of seeds, intensive use of chemical fertilizers and pesticides, and extensive tillage. This shift has now raised concerns about whether the Green Revolution in agriculture is sustainable and is it leading to a green economy?

In terms of land degradation, India is one of the most highly affected countries. Rain-fed areas have been seriously affected by land degradation. The agricultural community is of the view that, after the

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creation of access to fresh water, measures to curb soil degradation is the key factor in making agriculture viable for small landholders. There is no single, simple and unique solution to address the problem of soil degradation universally. A local, integrated and action-oriented soil fertility management strategy is essential.

The Integrated Soil Fertility Management (ISFM) adopts the maximization of efficiency of nutrients and water to improve land productivity. ISFM strategies include the combined use of chemical fertilizers (both macro and micronutrients) and organic matter (crop residue, compost and green manure), followed by the use of appropriate crop rotation and inter-cropping with legumes (a crop that fixes atmospheric nitrogen).

The Sehgal Foundation adopted the ISFM approach in Nuh district, a rain-fed district of Haryana. The soil of the district has, over the years, become highly degraded due to the injudicious use of chemical fertilizers. The traditional practices of leaving no crop residue on the farmland and decreasing the supply of organic manure have adversely affected the physical, chemical and biological properties of the soil. As a result, the average productivity of major crops such as wheat, mustard and millet are lower than the state average. To revitalize the soil of small landholders, the Sehgal Foundation encourages the farmers to adopt several interventions such as crop-specific soil nutrient management, the cultivation of legume crops (pigeon pea and chickpea), new methods to prepare organic manure quickly, green manuring, and the adoption of crop rotation.

Providing the solution locally, in 2012, the Sehgal Foundation, in collaboration with the state Agriculture Department, developed a soil fertility map of the district of Nuh, which covered 432 villages. One sample represented one square kilometre area. GPS was used to mark the location of each sample. Samples were tested at the Haryana government's soil testing laboratory in Karnal. The images in Figure 1 show the presence of different nutrients in the soil of Nuh district.

**A collection of soil samples for testing**

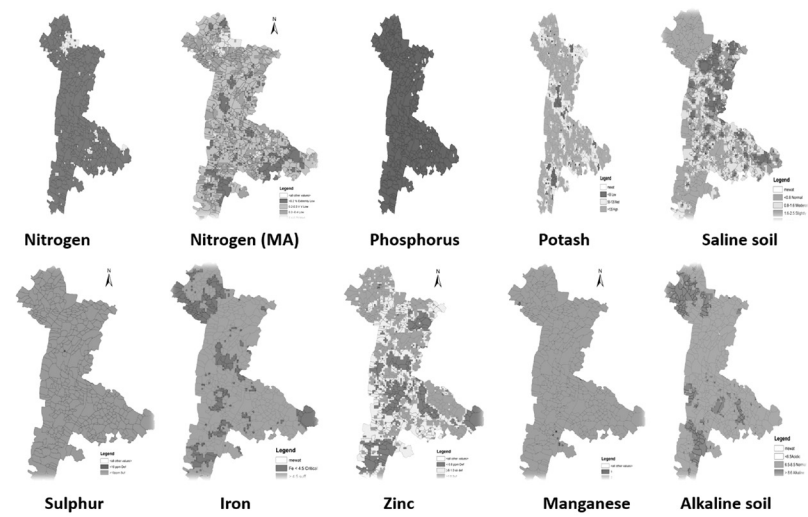



**Figure 1: Soil Fertility Map of Nuh District**

The district Agriculture Department and the Sehgal Foundation launched a campaign to bring about awareness of the importance of soil health management.

The following are the major findings from the soil analysis.

- The samples were found deficient in nitrogen, phosphorus, potash, zinc and iron.
- Nitrogen was found to be low in 87 per cent of the samples and phosphorus in 97 per cent of the samples.
- Zinc was critically low in 40 per cent of the samples.
- Except for a few pockets in Taoru, the percentage of iron in the district was normal.
- Approximately 60 per cent of the samples had soil salinity.
- Soil alkalinity was normal in most samples.

The district Agriculture Department and the Sehgal Foundation launched a campaign to bring about awareness of the importance of soil health management. In village meetings, farmers were trained on the use of crop-specific fertilizer recommendations and were motivated to increase the supply of good quality organic matter in their soil. In consultation with a researcher and plant nutritionist, a crop-specific Package of Practices (PoP) was developed. The PoP was demonstrated on a one-acre plot, wherein farmers were given all the essential nutrients, fertilizers and seeds for half an acre, (named the demo plot); they were instructed to follow their traditional practices on the remaining half acre, (named the control plot). Seeds were provided for the entire one acre of land so that the difference in crop growth and the yields between the demo and the control plot could not be attributed to the difference in the seed variety.

The results showed that using balanced fertilizers reduced cultivation costs and increased productivity. In addition, the use of micro-nutrients improved the quality of the grains and enhanced the tolerance of plants to stress. With support from corporate donors, the Sehgal Foundation initiated various related projects that provided these benefits to more than 10,000 farmers. The application of crop-specific PoP resulted in increased productivity of wheat by 20 per cent, mustard by 19 per cent, cotton by 25 per cent, onion by 27 per cent and millet by 24 per cent.

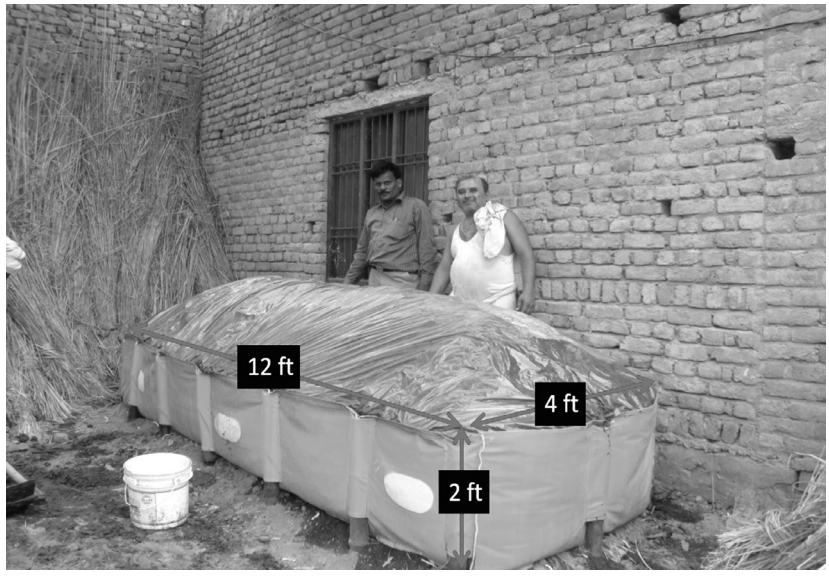
Jakir from Shishwana village says, “For many years, we have only been using urea and DAP. I had never heard the names of boron, potash, magnesium, zinc, etc. Since the Sehgal Foundation taught us the value of these inputs and showed us how to use them in the field, I used all the inputs in half an acre of land and saw a big difference in the crop. In the new practice, the germination was uniform, the root was well-developed and the sprouting was huge. I got approximately 2.5 quintals more wheat. The most important benefit that I saw, after using all these nutrients, was that my crop did not feel any dryness, even when the irrigation was late by 15 days. I, therefore, started using all the nutrients for all crops.”


**ISFM Practice in Millet (Left) and Wheat (Right)**

The application of well-decomposed manure increases the moisture-holding capacity, soil aeration and microbial activity in the soil. Fifty farmers adopted this technology and produced very good quality manure

The organic matter in soil plays a key role in improving the physical, chemical and biological properties of the soil. Over the years, due to a decline in the animal population, the supply of organic matter to farmlands has reduced considerably. In current practices, farmers are using smaller amounts of poorer quality (partially decomposed) manure. The application of the poorly decomposed organic matter invites termite attacks in the field. The Sehgal Foundation introduced compost beds to prepare good-quality manure for 40–45 days in summer and 80–90 days in winter whereas in traditional practices, it took 180–270 days. The compost bed is made of 430 gsm HDPE sheet and its size is 12 ft x 4 ft x 2 ft. This can be used through the year and farmers can prepare compost three times a year. The capacity of one bed is 18–20 quintals per unit. The application of well-decomposed manure increases the moisture-holding capacity, soil aeration and microbial activity in the soil. Fifty farmers adopted this technology and produced very good quality manure.

Dinesh, a farmer from Mandikhera village, says, "I used the compost bed for the first time. In the village, we used to put all the cow dung on the side of the road. After seven or eight months, we would use this manure in the field. It was not completely decomposed. I saw an increase in termite incidence because of using the half-decomposed material. This bag of compost made in this new way is very useful and gives us black, fully decomposed 'khad (manure)' in less time. Another advantage of this method is that it stops the supply of plastic, glass and other items that do not decompose in our fields. We get a sponge-like *khad*, which holds water, and the crop growth is very good."




**Compost bed prepared by farmers after training**

Pulses are legume crops and are considered to be climate-resilient in a rain-fed farming system. Pulses require less water, improve the organic content and fix the atmospheric nitrogen in the soil. The high market value of pulses brings a high return. In 2016, the Sehgal Foundation introduced a Short-Duration Pigeon Pea (SDPP) variety, the ICPL 88039 (released by ICRISAT) with the existing crop rotation in Nuh district. This variety matures in 150–160 days and allows farmers to grow the winter crop in time.

In addition to 209 farmers growing SDPP in the district, the Sehgal Foundation has extended their technical support to promote SDPP to 490 farmers in Alwar and Udaipur districts

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of Rajasthan and Ranchi district of Jharkhand. In addition, 163 women farmers grew SDPP in Pratapgarh and Umrain blocks in Alwar district, Rajasthan. This has led to an improvement in the income and in the nutritional security of women farmers. The crop economic analysis shows that the cultivation of short-duration pigeon pea provides an additional income of Rs 14,338 per acre as compared to millet, the traditional alternative *kharif* crop of Nuh district.

Sahabuddin from Naseerbaas village explains that he is growing pigeon pea after 10 years. He had stopped growing pigeon pea because it used to take a long time to mature and because he could not grow wheat in the rabi season then. The Sehgal Foundation gave him the SDPP variety, which matures in 150–160 days. Sahabuddin said growing this variety gave him enough time to prepare the field for wheat. This year, he got almost double the income from his pigeon pea crop than from the millet crop. Pigeon pea is good crop because it requires very little water and fertilizers. Its leaves add humus to the soil, which benenfit the rabi crop.

**Dhaincha cultivation to improve soil health**

Usually, *dhaincha* (Sesbania Bispinosa) is grown for green manure. It improves the soil's physical and chemical properties. In Nuh district, soil salinity affects more than two-thirds of the cultivable area and the use of saline water for irrigation constantly increases soil salinity. Therefore, *dhaincha* cultivation is of utmost importance in this region. As a practice, the farmers grow *dhaincha* every alternate year in the fields. For green manuring, the crop is mixed with the soil through a harrow or a cultivator once it is 45–60 days old and reaches a height of 120–150 cm. A 60-day crop provides 23.2 tonnes of dry matter per ha and accumulates 133 kg of nitrogen per ha. The Sehgal Foundation advises farmers to grow *dhaincha* either on the field's bund or as a pure plantation. The farmers endorse that mixing of green manure reduces soil salinity and improves soil moisture.

## Conclusion

Maintaining or improving soil health is essential for sustainable and productive agriculture in the semi-arid region. Healthy soil helps increase agricultural productivity. ISFM strategies assist farmers in following a scientific process for cultivation without eroding the soil's inherent capacity to produce more by maintaining its fertility level. The Sehgal Foundation adopted the ISFM approach in Nuh district and used multiple tools such as soil mapping, techniques for producing quality manure, developing a customised PoP, conducting field demonstrations and field days, promoting green manuring and following a legume-based crop rotation. The adoption of this multi-pronged approach has helped more than 10,000 farmers and has increased the productivity of the major crops of the region. The increased level of awareness and the adoption of these tools can help turn the current subsistence farming into productive farming.

*Pawan Kumar works with The Sehgal Foundation, Gurugram, Haryana*